

The temperature criterion applicable to the Columbia River in Oregon is:

“Unless specifically allowed under a Department-approved surface water temperature management plan as required under OAR 340-41-026(3)(a)(D), no measurable surface water temperature increase resulting from anthropogenic activities is allowed in the Columbia River or its associated sloughs and channels from the mouth to river mile 309 when surface water temperatures exceed 68.0 deg F (20.0 deg C).”

The water quality criterion applicable to the lower Columbia River in Washington:

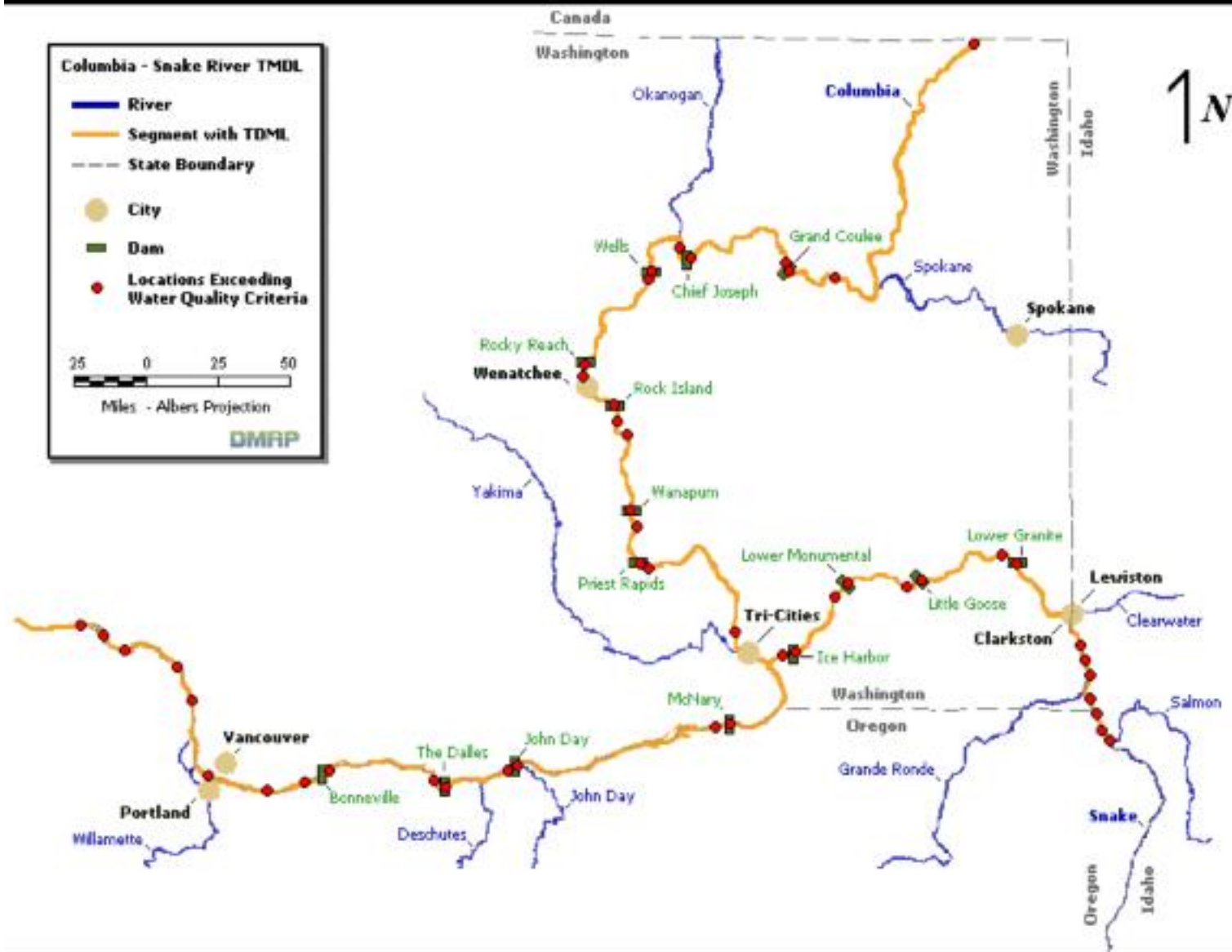
“Temperature shall not exceed 20 deg C (68 F) due to human activities. When natural conditions exceed 20 deg C (68 F) no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3 deg C (0.5 F) nor shall such temperature increases, at any time exceed 0.3 deg C (0.5 F) due to a single source or 1.1 deg C (2.0 F) due to all such activities combined.”

First step:

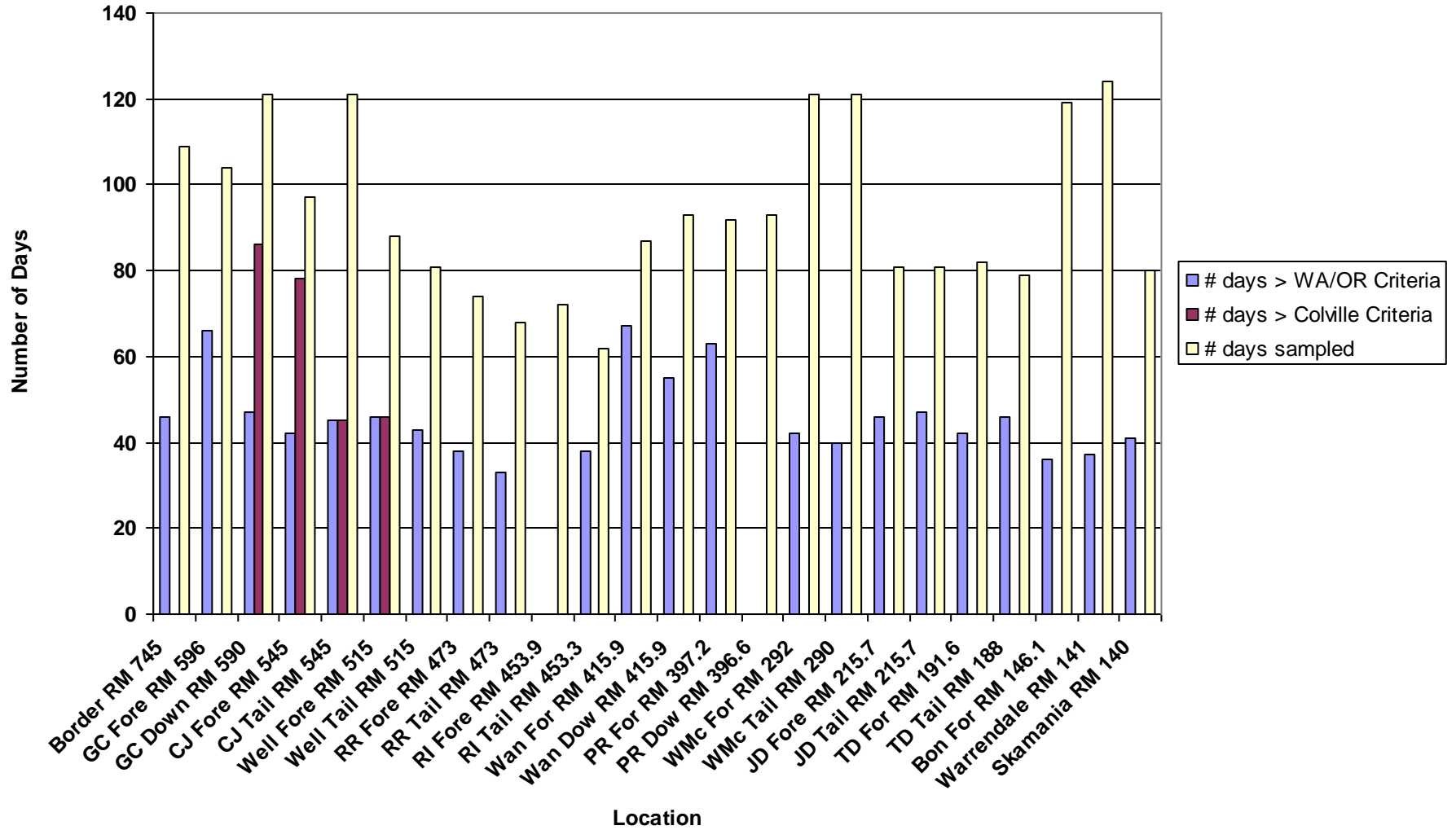
Compared temperature observations from the existing impounded river to state and tribal water quality criteria.

This revealed frequent exceedances of the criteria along the lengths of both impounded rivers within the study area.

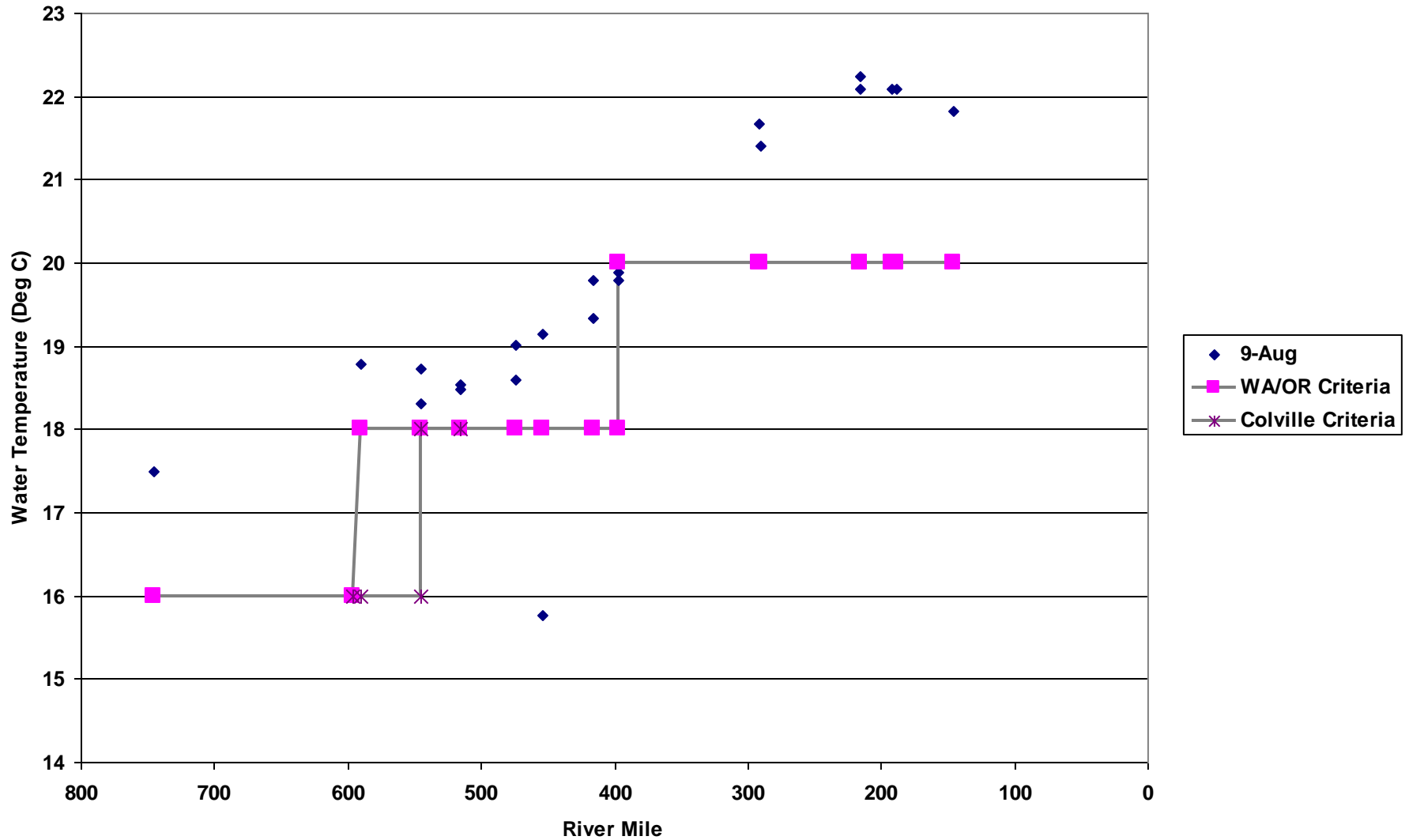
Geographic Scope



July Through October, 2000 - Number of Days during which Water Temperature along the Columbia River Exceeded Water Quality Criteria



Water Temperature Along the Columbia River on August 9, 2000

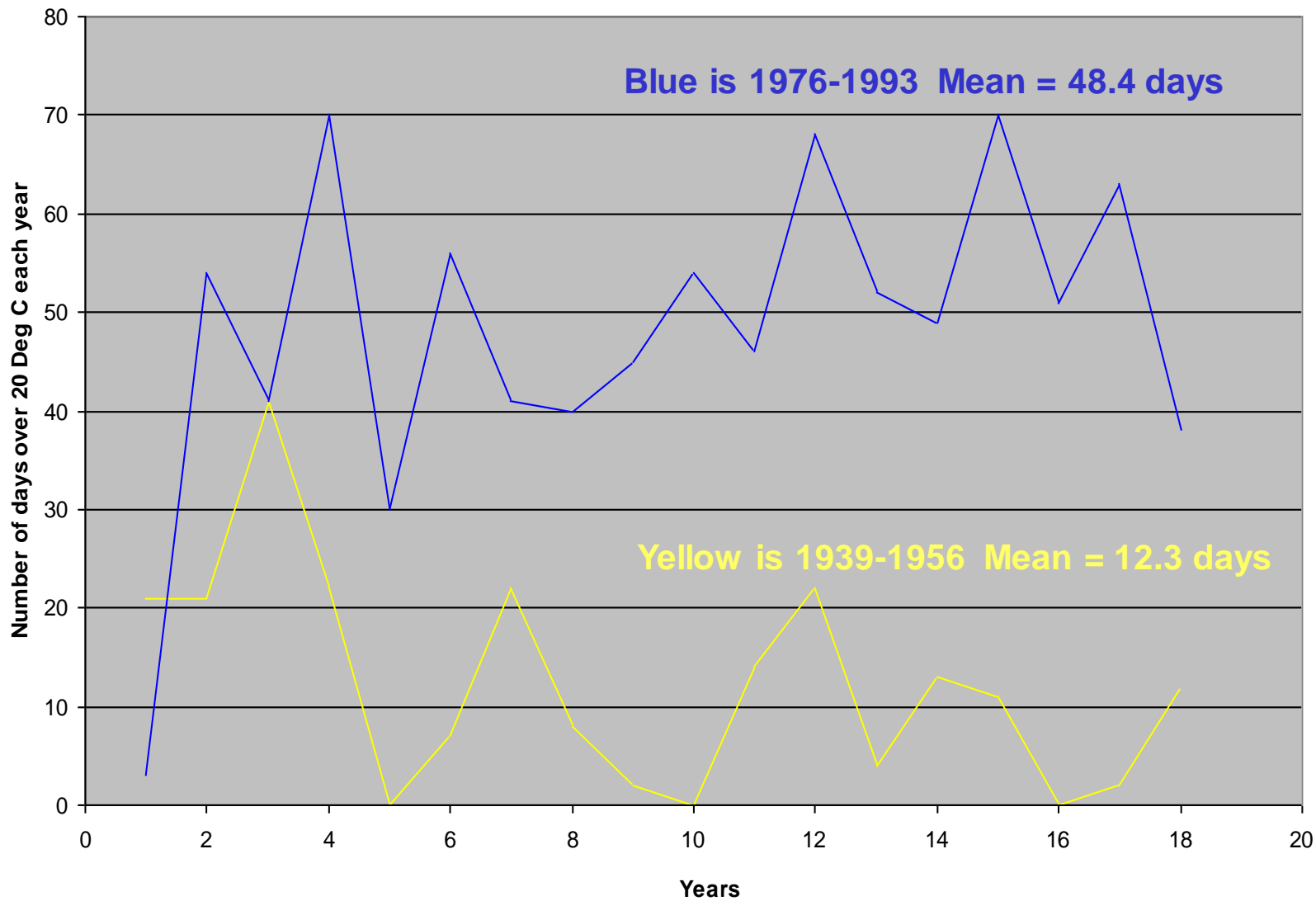


Second step:

Compare the frequency of exceedance of water quality criteria at Bonneville Dam for the time period 1939 - 1956 with the frequency of exceedance for the time period 1976 - 1993.

During the second time period after all the dams were in place, criteria were exceeded 4 times more frequently at Bonneville Dam (48 days/year versus 12 days/year).

**Number of Days that Exceed 20 Deg C at Bonneville Dam: Comparison of the two periods
1939-1956 and 1976-1993**



Third step:

Compared air temperature and river flow for the two time periods:

Days > 20 C		Days > 90 F		Days > 80 F	
<u>1939-1956</u>	<u>1976-1993</u>	<u>1939-1956</u>	<u>1976-1993</u>	<u>1939-1956</u>	<u>1976-1993</u>
12.3	48.4	17.7	18.4	64.3	63.8
Days < 50000 CFS		Days < 40,000 CFS			
<u>1939-1956</u>	<u>1976-1993</u>	<u>1939-1956</u>	<u>1976-1993</u>		
86.2	13.5	35.3	3.7		

Next:

Similar analysis for Rock Island Dam which was the only dam on the Columbia River for 9 years.

It does not have the same “before and after” relationship as Bonneville Dam.

Next:

Looked for literature evaluating trends in Frazer River temperature.

Found Foreman et al (2001):

Ave summer temperature increased 0.012 C from 1941- 1998.
This is not significant at the 95% confidence level.

Ave summer temperature increased 0.022 C from 1953 - 1998.
This is significant at the 98% confidence level. Most of this warming was attributed to climatic effects.

We also discussed literature showing:

Temperature gradients in the reservoirs;

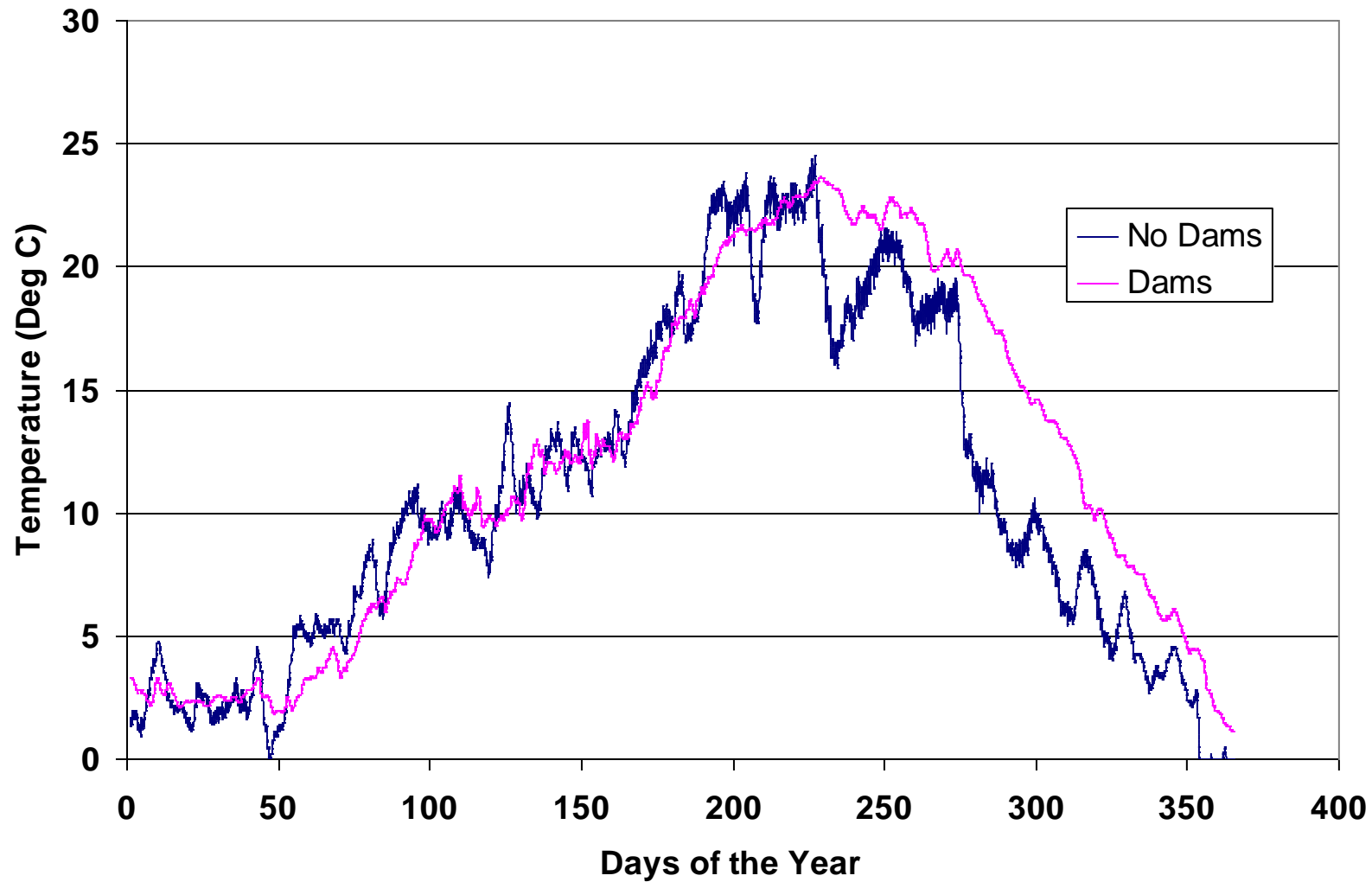
Elevated temperatures in the fish ladders;

Loss of cold water refugia due to the flooding of alluvial flood plains.

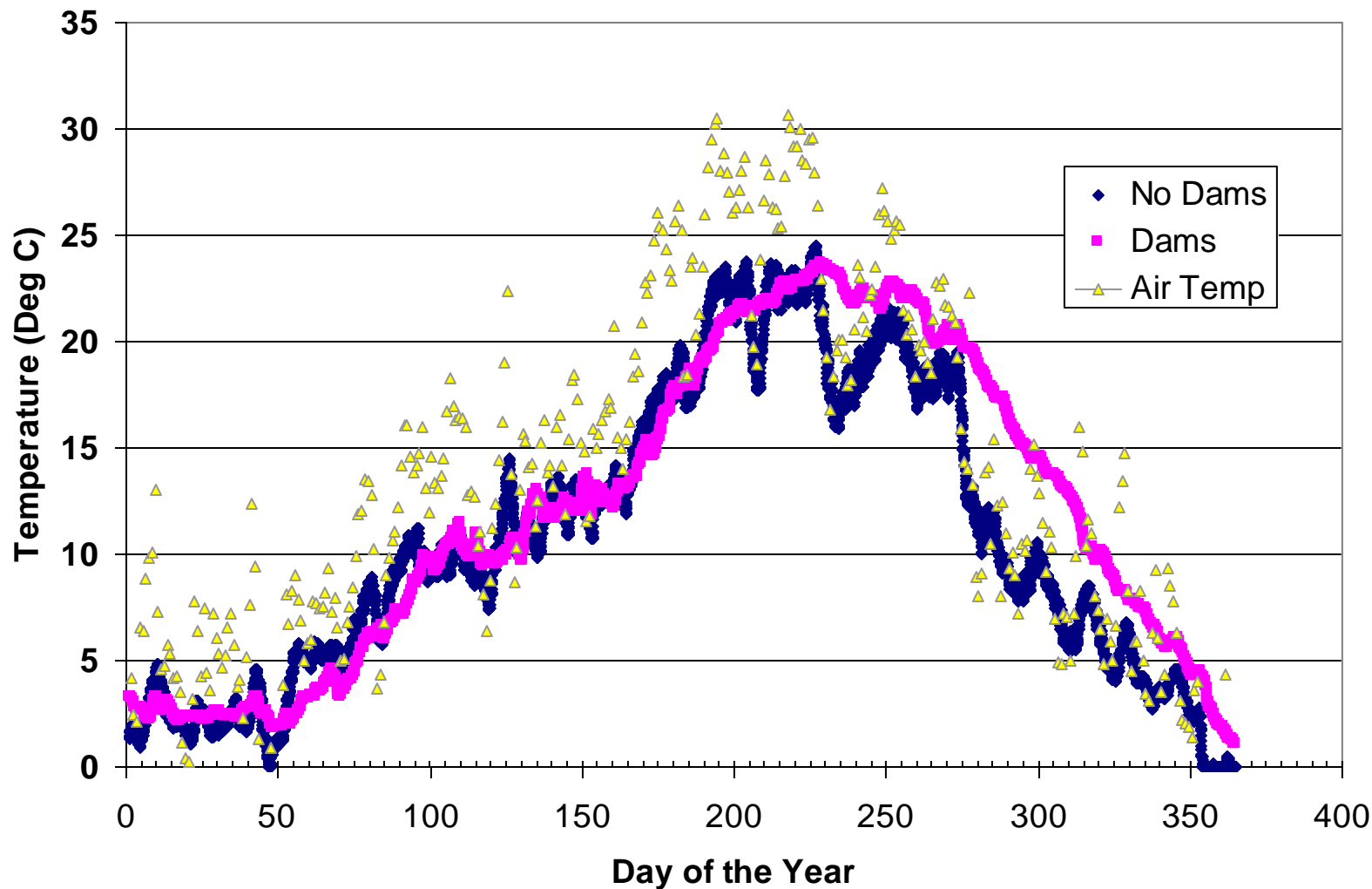
Then we used the model to further evaluate the differences in temperature between the free flowing (natural) rivers and the impounded rivers.

- The dams delay the cooling of the river in the fall and increase the frequency of exceedance of water quality criteria.
- Effects of the dams on the frequency of exceedance of water quality criteria far out weighs the effects of the tributaries;
- The dams decrease the diurnal and short term fluctuation of average water temperature in the rivers.

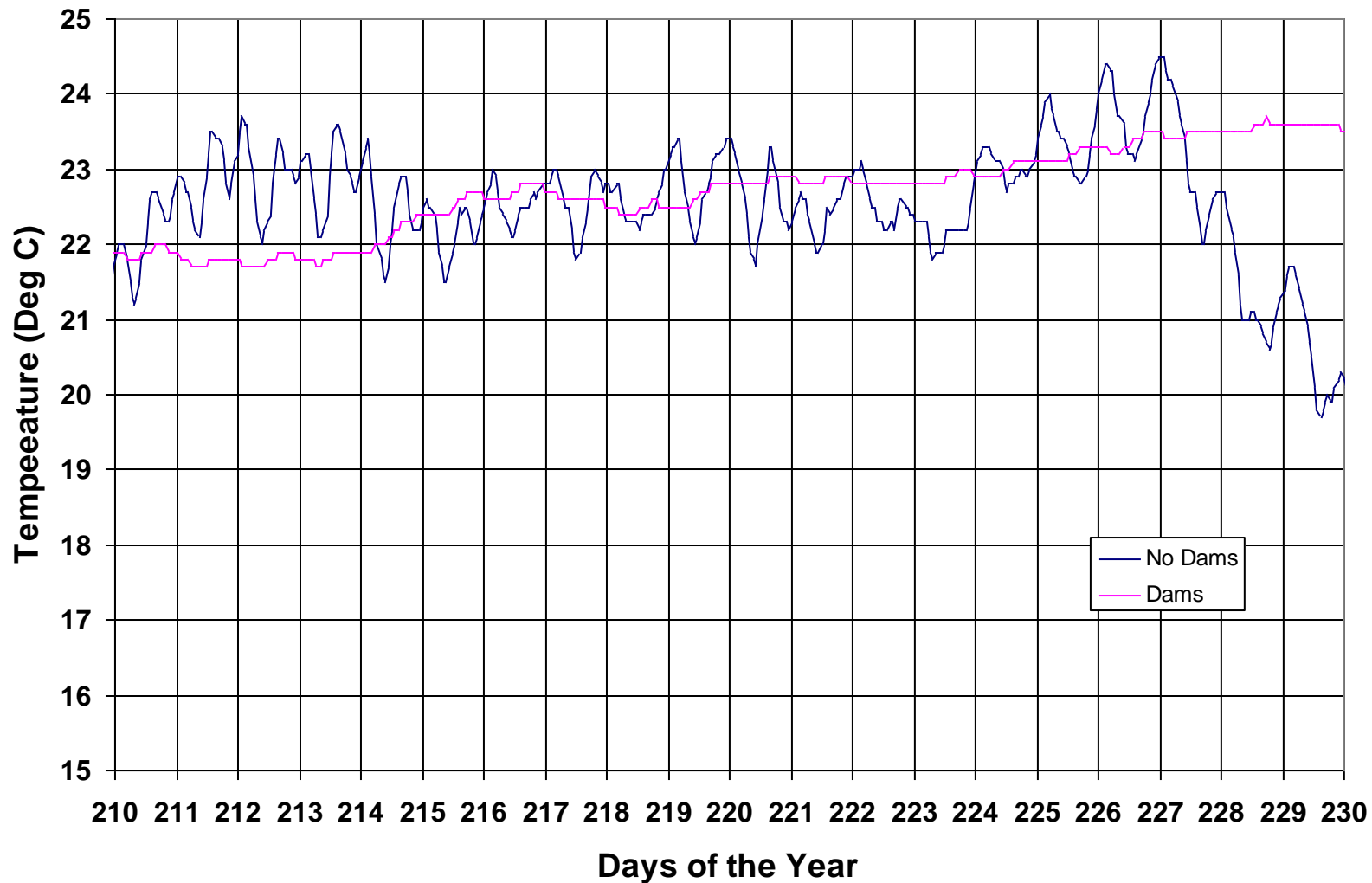
Figure 3-12. Simulated Water Temperature at Ice harbor Dam 1990 - Dams in Place and Dams Removed



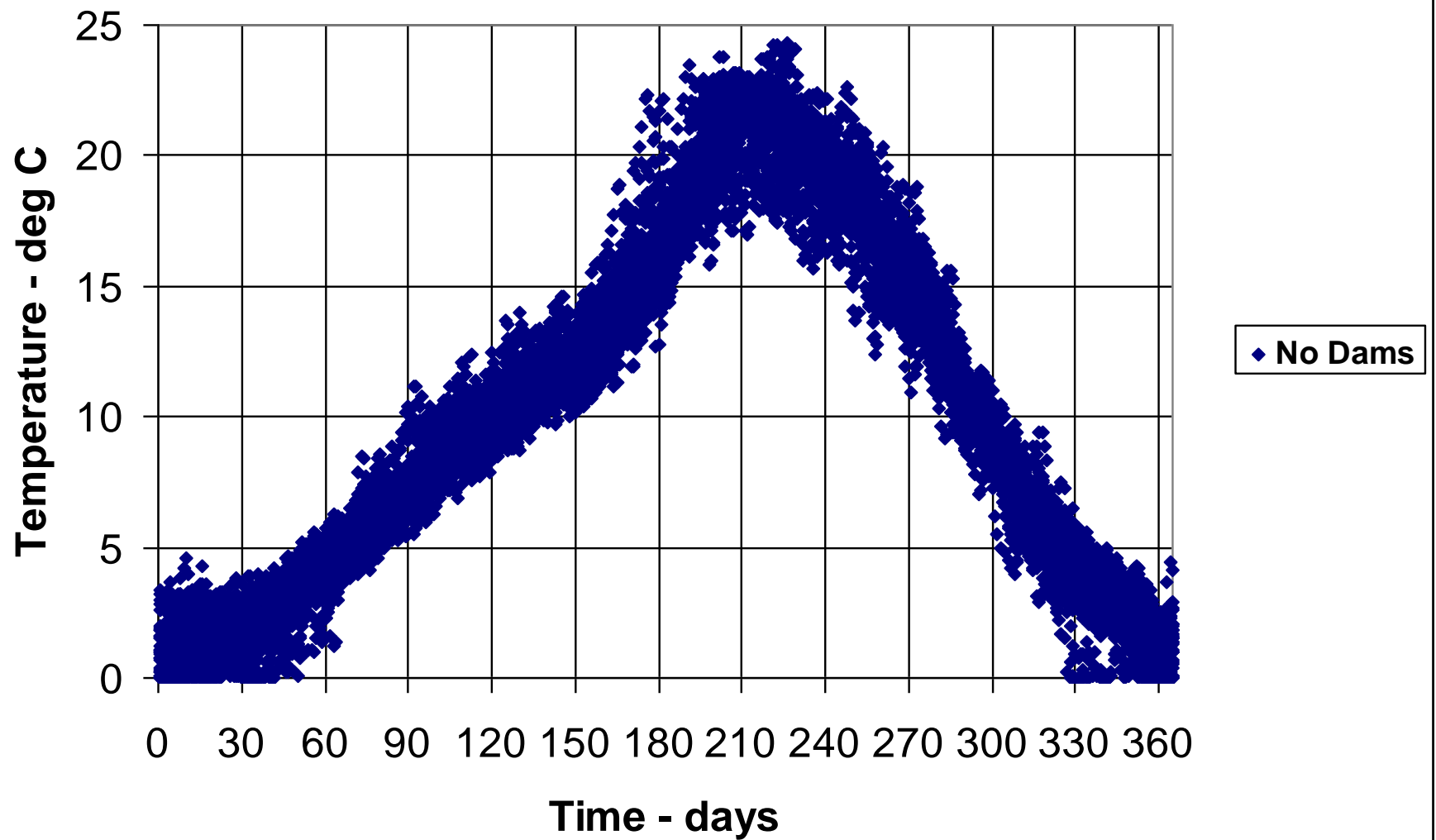
Simulations of Water Temperature at Ice Harbor Dam 1990 with Dams in Place and Dams Removed Compared to Air Temperature at Lewiston, ID



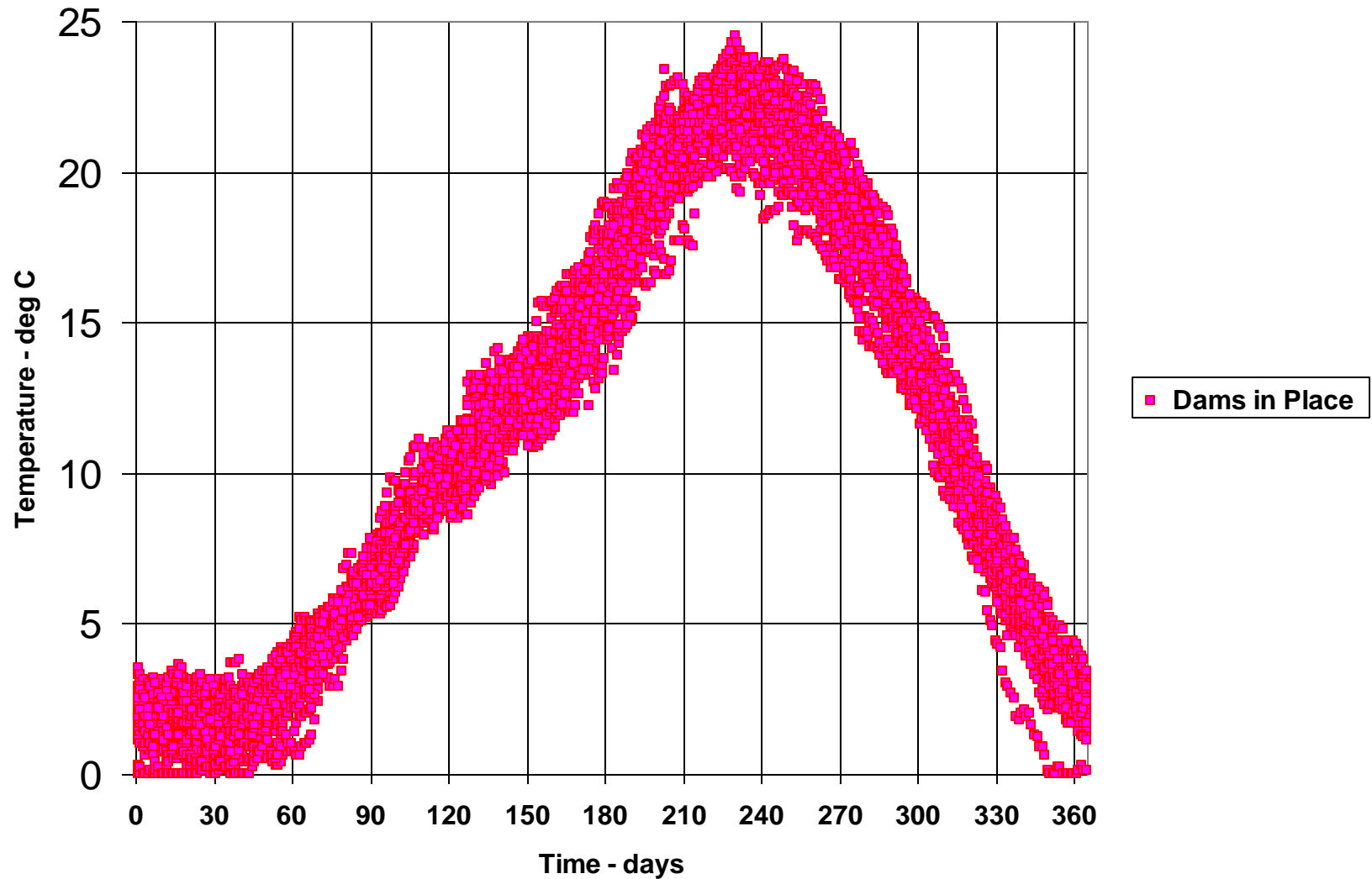
Simulated Water Temperature at Ice Harbor Dam 1990 - Dams in Place and Dams Removed



Simulations of Water Temperatures at Ice Harbor Dam 1970-1999 with No Dams in Place



Simulations of Water Temperatures at Ice Harbor Dam 1970-1999



Simulations of Water Temperature at Ice Harbor Dam 1970-1999

